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BEFORE THE BOARD OF PATENT APPEALS AND INTERFERENCES

Application Number: 10/670,673
Filing Date: September 25, 2003
Appellant(s): WACHTMANN, BRUCE K.

Mr. John L. Conway, reg. No. 48,241
For Appellant

EXAMINER'S ANSWER

This is in response to the appeal brief filed on 3/31/2007 appealing from the Office action mailed on 4/24/2006.

(1) Real Party in Interest

A statement identifying by name the real party in interest is contained in the brief.

(2) Related Appeals and Interferences

The examiner is not aware of any related appeals, interferences, or judicial proceedings that will directly affect or be directly affected by or have a bearing on the Board's decision in the pending appeal.

(3) Status of Claims

The statement of the status of claims contained in the brief is incorrect because it fails to include the status of all the cancelled claims. A correct statement of the status of all the claims is as follows:

This appeal involves claims 1, 3-5, 7, 8, and 15-19.

Claims 9-14 and 20 were withdrawn from consideration as not directed to the elected invention.

Claims 2 and 6 have been canceled.

(4) Status of Amendments After Final

No amendment after final has been filed.

(5) Summary of Claimed Subject Matter

The summary of claimed subject matter contained in the brief is correct.

(6) Grounds of Rejection to be Reviewed on Appeal

The appellant's statement of the grounds of rejection to be reviewed on appeal is correct.

(7) Claims Appendix

The copy of the appealed claims contained in the Appendix to the brief is correct.

(8) Evidence Relied Upon

20040152272	FLADRE	8-2004
5798283	MONTAGUE	8-1998
6160314	LEE	12-2000
6500763	KIM	12-2002

(9) Grounds of Rejection

The following ground(s) of rejection are applicable to the appealed claims:

Claims 1, 3-5, 7, 8, and 15-18 are rejected under 35 U.S.C. 103(a) as being unpatentable over Montague (US 5798283) in view of Kim (US 6500763) and Lee (US 6160314).

Regarding claim 1, Montague shows (see, *e.g.*, fig. 1) most aspects of the instant invention including a method of forming a surface micromachined MEMS device **12**, the method comprising:

- ✓ Providing a substrate **14**
- ✓ Applying an insulating layer **22** on the substrate **14** (see, *e.g.*, col.5/ll.30-35)
- ✓ Depositing a conductive path **24** directly on the insulating layer **22**
- ✓ Forming circuitry **16** and structure **26**
- ✓ Connecting the path **24** between the circuitry **16** and the structure **26**

wherein:

- ✓ The conductive path **24** is capable of transmitting an electronic signal between the circuitry **16** and the structure **26**
- ✓ The insulating layer **22** spaces the path **24** from the substrate **14**

- ✓ The device **12** is free of semiconductor junctions formed by the substrate **14** and the conductive path **24**

Montague, however, fails to show the conductive path directly on an oxide layer. He differently teaches the conductive path being deposited directly on a nitride layer, which is to be used as a polishing stop layer and as an etch stop layer (see, *e.g.*, col.5/ll.39-47).

Kim (see, *e.g.*, col.4/ll.15-20) and Lee (see, *e.g.*, col.2/ll.55-60), on the other hand, teach an oxide layer to be an equivalent material to Montague's nitride layer for its use as an etch/polish stop layer. They further add that this oxide layer has a high polishing and etching selectivity, the same as Montague's nitride layer.

Therefore, it would have been obvious at the time of the invention to one of ordinary skill in the art to use either an oxide or a nitride in Montague's method because these were recognized in the semiconductor art as equivalents for their use as etch/polish stop materials, as taught by Kim and Lee, and the selection of any of these known equivalents would be within the level of ordinary skill in the art.

Regarding claims 3 and 16, Montague shows the structure **26** is electrically isolated from the substrate **14** (see, *e.g.*, fig. 1).

Regarding claims 4 and 18, Montague shows (see, *e.g.*, fig. 10) the method further comprising:

- ✓ Applying an additional insulator **42** above the conductive path **24**
- ✓ Depositing an additional conductive path **44** to the additional insulator **42**

wherein the conductive path **24** and the additional conductive path are in different planes of the device.

Regarding claim 5, Montague shows the method further comprising electrically connecting the conductive path **24** and the additional conductive path **44** with a connector **28**, the connector **28** being one of a via and a staple (see, *e.g.*, fig. 10).

Regarding claim 7, Montague shows the substrate **14** is free of embedded electrodes (see, *e.g.*, fig. 2).

Regarding claim 8, Montague shows the conductive path **24** comprises polysilicon (see, *e.g.*, col.6/ll.47).

Regarding claim 15, Montague shows (see, *e.g.*, fig. 1) all aspects of the instant invention including a method of forming a sensor, the method comprising:

- ✓ Forming an oxide **22** on a substantially intrinsic semiconductor substrate **14** (see, *e.g.*, col.5/ll.30-35 and col.4/ll.45)
- ✓ Forming a conductive path **24** on the oxide **22**
- ✓ Forming circuitry **16** and structure **26**
- ✓ Connecting the path **24** between the circuitry **16** and the structure **26**

wherein:

- ✓ The oxide **22** and the conductive path **24** are formed by surface micromachining processes (see, *e.g.*, col.5/ll.50-55)
- ✓ The oxide **22** electrically isolates the conductive path **24** from the substrate **14**
- ✓ The conductive path **24** is capable of transmitting an electronic signal between the circuitry **16** and the structure **26**

Montague, however, fails to show the conductive path directly on an oxide layer. He differently teaches the conductive path being deposited directly on a nitride layer, which is to be used as a polishing stop layer and as an etch stop layer (see, *e.g.*, col.5/ll.39-47).

Kim (see, *e.g.*, col.4/ll.15-20) and Lee (see, *e.g.*, col.2/ll.55-60), on the other hand, teach an oxide layer to be an equivalent material to Montague's nitride layer for its use as an etch/polish stop layer. They further add that this oxide layer has a high polishing and etching selectivity, the same as Montague's nitride layer.

Therefore, it would have been obvious at the time of the invention to one of ordinary skill in the art to use either an oxide or a nitride in Montague's method because these were recognized in the semiconductor art as equivalents for their use as etch/polish stop materials, as taught by Kim and Lee, and the selection of any of these known equivalents would be within the level of ordinary skill in the art.

Regarding claim 17, Montague shows the MEMS device **12** is free of semiconductor junctions between the substrate **14** and the conductive path **24** (see, *e.g.*, fig. 1).

Claim 19 is rejected under 35 U.S.C. 103(a) as being unpatentable over Montague/Kim/Lee in view of Fladre (US 2004/0152272).

Regarding claim 19, Montague/Kim/Lee shows most aspects of the instant invention (see, *e.g.*, paragraphs above). Kim/Lee, however, fails to specify the thickness of the oxide layer. Montague, on the other hand, shows the insulating layer comprising an oxide layer having a thickness of about .06 μm (see, *e.g.*, col.5/ll.30-32) but also fails to show the claimed thickness of .15 to 1.5 μm. However, differences in

thickness will not support the patentability of subject matter encompassed by the prior art unless there is evidence indicating such differences are critical. "Where the general conditions of a claim are disclosed in the prior art, it is not inventive to discover the workable ranges by routine experimentation". *In re Aller*, 220 F.2d 454,456,105 USPQ 233, 235 (CCPA 1955). Along these lines, Fladre teaches (see, *e.g.*, par. 0050) that the larger the thickness of Kim/Lee's oxide layer is, the more the parasitic capacitance between the conductive path and the substrate will be reduce. The original thickness of Fladre's oxide layer ranges from .400 to 1.000 μm (see, *e.g.*, par. 0048).

Based on the teachings of Fladre, the specific claimed thicknesses, are only considered to be the "optimum" thicknesses disclosed by Montague/Kim/Lee that a person having ordinary skill in the art would have been able to determine using routine experimentation based, among other things, on the desired reduction in parasitic capacitance, manufacturing costs, etc. (see Boesch, 205 USPQ 215 (CCPA 1980)), and since neither non-obvious nor unexpected results, *i.e.*, results which are different in kind and not in degree from the results of the prior art, will be obtained as long as an oxide insulator separates the conductive path from the substrate, as already suggested by Montague/Kim/Lee.

Accordingly, since the applicants have not established the criticality (see next paragraph below) of the stated thicknesses and since these thicknesses have been in common use in similar devices in the art, as shown by Fladre, it would have been obvious to one of ordinary skill in the art to use these values in the method of Montague/Kim/Lee.

CRITICALITY

The specification contains no disclosure of either the critical nature of the claimed thicknesses or any unexpected results arising therefrom. Where patentability is said to be based upon particular chosen dimensions or upon another variable recited in a claim, the applicant must show that the chosen dimensions are critical. *In re Woodruff*, 919 F.2d 1575, 1578, 16 USPQ2d 1934, 1936 (Fed. Cir. 1990).

(10) Response to Argument

The appellant argues:

> Claim 1 in the subject application requires "depositing a conductive path directly on an oxide" that was applied to a semiconductor substrate. Montague does not teach such a process. Instead, the Montague reference teaches depositing polysilicon **24** directly on a silicon-nitride insulating layer **22** (see, *e.g.*, fig. 1 and col.6/ll.8-13). Lee never teaches or suggests that nitride and oxide are interchangeable substitutes when used as a *singular* insulating layer over a semiconductor substrate. Therefore, there is no suggestion or motivation to combine Lee and Montague to achieve the embodiment of claim 1.

The examiner responds:

Claim 1 fails to recite that the oxide layer be used as a *singular* insulating layer over the substrate. There is also no limitation in claim 1 reciting that the oxide layer be directly on the substrate. The only limitation in claim 1 with respect to the oxide layer is that the layer be applied on a substrate and that the conductive path be directly on the oxide. Montague shows forming a silicon nitride layer **22** on a substrate **14** (see, *e.g.*, fig. 1). To protect the substrate, a thin silicon oxide layer is formed between the silicon nitride layer and the substrate (see, *e.g.*, col.5/ll.30-35). A conductive path **24** is formed directly on the silicon nitride layer **22** (see, *e.g.*, fig. 1).

Montague fails to teach forming the conductive path **24** directly on an oxide layer and differently teaches forming the conductive path **24** directly on the silicon nitride layer **22** (see, *e.g.*, fig. 1). However, the combination of Montague, Kim and Lee, teach forming the conductive path **24** directly on an oxide. Kim and Lee teach substituting Montague's nitride layer for an oxide layer. Montague's silicon nitride layer is to be

used as a polishing stop layer and as an etch stop layer (see, *e.g.*, col.5/ll.39-47). Kim (see, *e.g.*, col.4/ll.15-20) and Lee (see, *e.g.*, col.2/ll.55-60), on the other hand, teach an oxide layer, *i.e.*, aluminum oxide, to be an equivalent material to Montague's nitride layer for its use as an etch/polish stop layer.

The appellant has failed to refute the teachings of the prior art that aluminum oxide (an oxide) and silicon nitride are equivalent materials for their use as etch/polish stop layers. Therefore, it would have been obvious at the time of the invention to one of ordinary skill in the art to replace the nitride in Montague's layer 22 with an oxide because these were recognized in the semiconductor art as equivalents for their use as etch/polish stop materials, as taught by Kim and Lee, and the selection of any of these known equivalents would be within the level of ordinary skill in the art.

The appellant argues:

> To provide a motivation or a suggestion to replace Montague's nitride layer **22** with an oxide layer, a reference would need to teach or suggest that the materials are fully equivalent in an application such as the insulating layer **22** in Montague's device. Lee never describes nitride and oxide as interchangeable substitutes when used as a *singular* insulating layer over a semiconductor substrate. That is the function performed by Montague's insulating layer **22**. Instead, Lee mentions that in the polishing stop layer (layer **206**) of the complex sandwich shown in fig. 2A, one or more materials would work.

The examiner responds:

Contrary to what the appellant argues above, Montague does not teach using the silicon nitride layer **22** as a *singular* insulating layer over a semiconductor substrate. He clearly teaches forming the silicon nitride layer over a silicon oxide dielectric layer (see, *e.g.*, col.5/ll.30-35).

Likewise, Lee shows forming a silicon nitride layer **206** over a silicon oxide dielectric layer **202** (see, *e.g.*, fig. 2A and col.2/ll.55). As acknowledged by the

appellant, Lee also teaches that other materials could work as the polishing stop **206** in the complex sandwich structure depicted in fig. 2A.

Whether the structure in fig. 2A is a complex sandwich or not is irrelevant to the fact that layer **206** is a polishing stop. That is, layer **206** would still be a polishing stop layer regardless of the complexity of the structure depicted in fig. 2A. It is the good resistance to polishing that makes layer **206** a polishing stop layer (see, *e.g.*, Lee: col.3/ll.11-14 and col.2/ll.56-57).

Performing as a polishing stop layer is one of the attributes of the silicon nitride layer of Montague (see, *e.g.*, col.5/ll.39-42) and, as the appellant stated, Lee teaches that not only silicon nitride but also aluminum oxide (an oxide) could serve that purpose in Montague's device (see, *e.g.*, Lee: col.2/ll.54-57). The appellant has failed to refute the teachings of the prior art that aluminum oxide (an oxide) and silicon nitride are equivalent materials for their use as polish stop layers.

Therefore, it would have been obvious at the time of the invention to one of ordinary skill in the art to use an oxide layer instead of Montague's silicon nitride layer because these were recognized in the semiconductor art as equivalents for their use as polish stop materials, as taught by Lee, and the selection of any of these known equivalents would be within the level of ordinary skill in the art.

The appellant argues:

> Performance as a polishing stop is but one attribute of Montague's silicon nitride insulating layer 22. For example, Montague states that "the remainder of the nitride layer 22 covering the inner surfaces of each cavity 20 will serve as a dielectric isolation layer and also as an etch stop layer (see, *e.g.*, Montague: col.5/ll.42-44).

The examiner responds:

Kim and Lee teach that aluminum oxide is an equivalent material to Montague's silicon nitride layer (see, *e.g.*, Lee:col.2/ll.54-57 and Kim:col.4/ll.12-20). Like silicon nitride, aluminum oxide is a dielectric material and consequently if substituted for Montague's silicon nitride layer would also serve as a dielectric isolation layer.

Kim (see, *e.g.*, col.4/ll.15-20) also teaches aluminum oxide to be an equivalent material to Montague's nitride layer for its use as an etch stop layer. The appellant has failed to refute the teachings of the prior art that aluminum oxide (an oxide) and silicon nitride are equivalent materials for their use as etch stop layers.

Therefore, it would have been obvious at the time of the invention to one of ordinary skill in the art to replace Montague's silicon nitride layer with an oxide layer because these were recognized in the semiconductor art as equivalents for their use as etch/polish stop materials, as taught by Kim and Lee, and the selection of any of these known equivalents would be within the level of ordinary skill in the art.

The appellant argues:

> Montague also states that a second nitride layer **34** is deposited to form a nitride-to-nitride seal with the nitride layer **22** for sealing the encapsulated MEM device (see, *e.g.*, col.7/ll.17-22). A reference would need to teach equivalence of all pertinent properties of an oxide for the silicon nitride layer **22** in Montague's application to provide a suggestion to replace a nitride with an oxide—such properties include the dielectric constant of the material, the ability to form a seal with Montague's cap layer **34**, etc.

The examiner responds:

With regards to the dielectric constant of the material of layer **22**, Montague fails to teach that the material of layer **22** was selected based in its dielectric constant.

With regards to the ability of layer **22** to form a seal with Montague's cap layer, forming a seal would only require following Montague's method steps. Applying Lee's teachings of equivalency so as to use aluminum oxide for Montague's layer **22** does not

eliminate the step of forming the layer nor does it eliminate or change the sequence of any of the subsequent method steps. That is, Lee is not suggesting eliminating layer **22** or eliminating, disrupting, or changing the sequence of any of Montague's method steps. Lee is only suggesting an alternative material to be used when forming Montague's layer **22**. Therefore, once it is formed, Montague's cap layer **34** will still form a seal with layer **22** as there is nothing in Lee's teachings that would affect the way in which Montague's method steps are performed. It should be kept in mind that this seal is only temporary and is meant to protect the MEM device **12** while forming CMOS circuitry **16** (see, *e.g.*, Montague:figs.8-10, col7/ll.22-27 and col.7/ll65-col.8/ll.2).

The appellant argues:

> Montague effectively teaches away from using an oxide layer for the silicon nitride 22, since the silicon nitride layer is already formed on a thin oxide layer. If silicon dioxide were a suitable substitute for the nitride layer in Montague's device, Montague could have used a single, thicker layer of silicon dioxide in place of the more complex nitride on silicon dioxide layers in the device Montague described.

The examiner responds:

The oxide layer over which the silicon nitride layer is formed is a silicon dioxide layer (see, *e.g.*, Montague:col.5/ll.33). Lee and Kim are not suggesting replacing silicon nitride with silicon dioxide. Lee and Kim are suggesting another oxide for replacing silicon nitride. They teach aluminum oxide to be an equivalent material to Montague's nitride layer for its use as an etch/polish stop layer. See, *e.g.*, Kim:col.4/ll.15-20 and Lee:col.2/ll.55-60. The appellant has failed to refute the teachings of the prior art that aluminum oxide (an oxide) and silicon nitride are equivalent materials for their use as etch/polish stop layers. Therefore, it would have been obvious at the time of the invention to one of ordinary skill in the art to use an oxide layer instead of Montague's

silicon nitride layer because these were recognized in the semiconductor art as equivalents for their use as etch/polish stop materials, as taught by Kim and Lee, and the selection of any of these known equivalents would be within the level of ordinary skill in the art.

The appellant argues:

> Kim's conductor **310** lies between substrate **100** and the etch stop layer **500**. While Kim teach an etch stop layer may either be a nitride or an oxide, one skilled in the art could not infer from Kim's teachings that Montague's insulating layer **22** could equally well be either a nitride or an oxide. Montague's insulating layer **22** lies between the conductive path **24** and the substrate **14**.

The examiner responds:

As acknowledged by the appellants, Kim teaches that a nitride or an oxide could be used as etch stop layers (see, *e.g.*, Kim:col.4/ll.17-20). One skilled in the art would understand that neither Kim's nitride layer nor the oxide layer would loose their etch stop characteristics because of their position with respect to another conductive layer. Whether Kim forms an etch stop layer in a different position than Montague is irrelevant to the fact that Kim teaches that aluminum oxide (an oxide) is an equivalent material to Montague's silicon nitride for their use as an etch stop layer.

The appellant has failed to refute the teachings of the prior art that aluminum oxide (an oxide) and silicon nitride are equivalent materials for their use as etch stop layers. Therefore, it would have been obvious at the time of the invention to one of ordinary skill in the art to use an oxide to replace Montague's silicon nitride layer because these were recognized in the semiconductor art as equivalents for their use as etch stop materials, as taught by Kim, and the selection of any of these known equivalents would be within the level of ordinary skill in the art.

(11) Related Proceeding(s) Appendix

No decision rendered by a court or the Board is identified by the examiner in the Related Appeals and Interferences section of this examiner's answer.

For the above reasons, it is believed that the rejections should be sustained.

An appeal conference was held on 5/16/2007 between Mr. Marcos D. Pizarro (Primary Patent Examiner), Mr. Wael Fahmy (Supervisory Patent Examiner), and Mr. Ricky L. Mack (Supervisory Patent Examiner) as the conferees.

Respectfully submitted,

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